OSEs to Evaluate NOAA Ocean (TAO) Observational System

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Why Ocean (TAO) OSE?

- **NOAA has $6-7M outlay/year to maintain US part of TAO/TRITON array;**

- **Availability of ship time keeps getting harder;**

- **Questions come up if there are other technologies available (e.g., Iridium Argo), can they be a good alternative?**

- **We continuously get questions on can we quantify the "utility" of TAO for seasonal predictions?**

Why Ocean (TAO) OSE?

- **To answer some of the questions that are being raised, we need a sound scientific approach, and OSE may have that capability**

- **As the users of TAO array for seasonal predictions, we also have certain obligations to quantify the utility of TAO array**
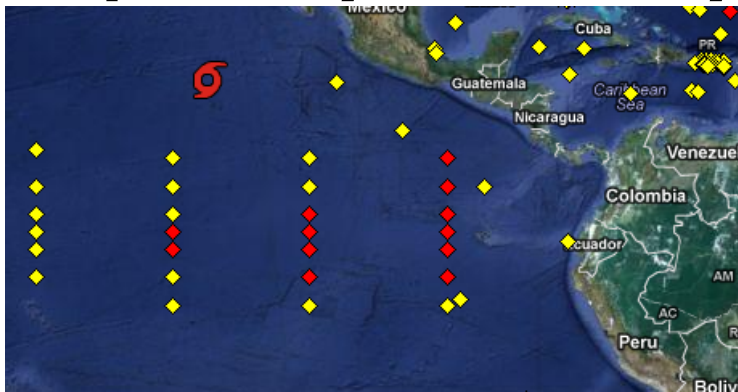
TAO – Oct 8
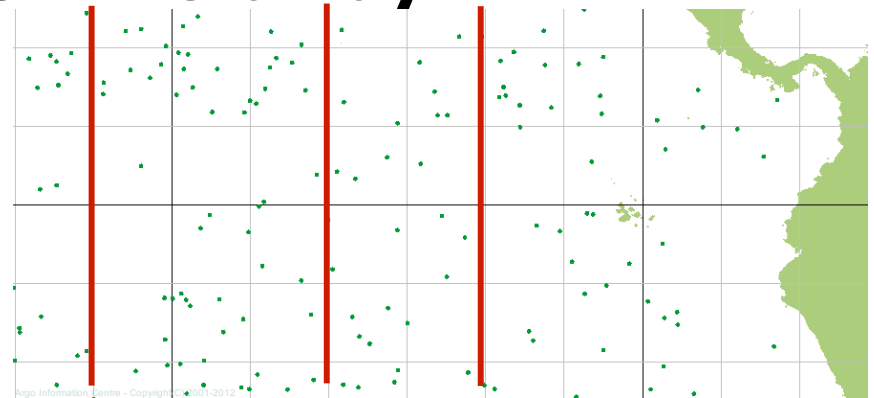
Argo – Oct 8

OSE Experiment

- **Design of experiments sort of depends on kind of question one wants to answer**
  - **How much TAO contributes to skill of seasonal forecasts**
    - **During Argo era (after 2004)**
    - **During pre Argo era (1990-2004)...but this only is of historical importance**
  - **How well alternate observing systems can fill in?**

OSE Experiment

- **OSE approach has to be a multi-analysis approach;**

- **Towards this we have started a dialog between NCEP, GFDL, and GMAO [with support from the Office of Climate Observations (OCO)]**

- **This will be a good NCEP-GFDL collaborative project for the benefit**

OSE Experiments with GODAS_MOM4p0

(on Vapor, discontinued in April 2012)

Data assimilated	CTL (no Ocean Data) (1990-2008)	STD (all Ocean Data) (1990-2008)	nTAO (All Ocean Data Except TAO) (1990-2008)	nArgo (all Ocean data except Argo) (1999-2008)	nTAO_nArgo (all ocean data except TAO and Argo) (1999-2008)
XBT	×	√	√	√	√
TAO	×	√	×	√	×
Argo	×	√	√	×	×

Table 1. Experiment runs conducted with GODAS_MOM4p0 system in which various observations (XBT, TAO and Argo) were selectively assimilated (√) or not assimilated (×).
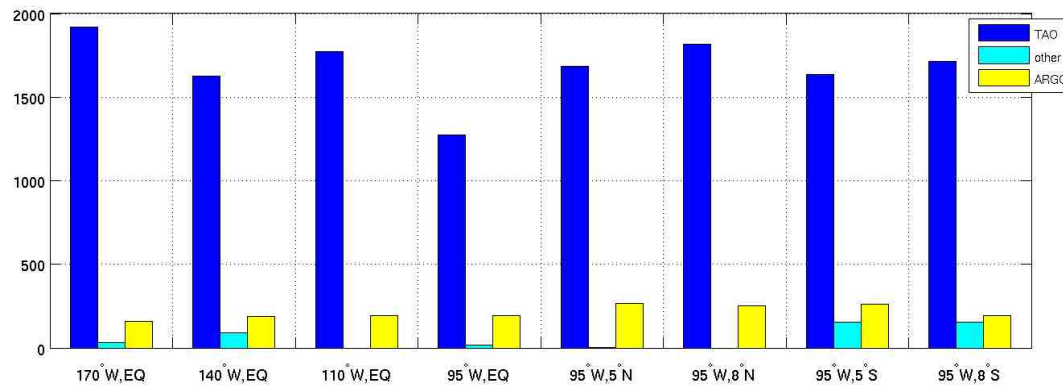
Comparison with Altimetry SSH
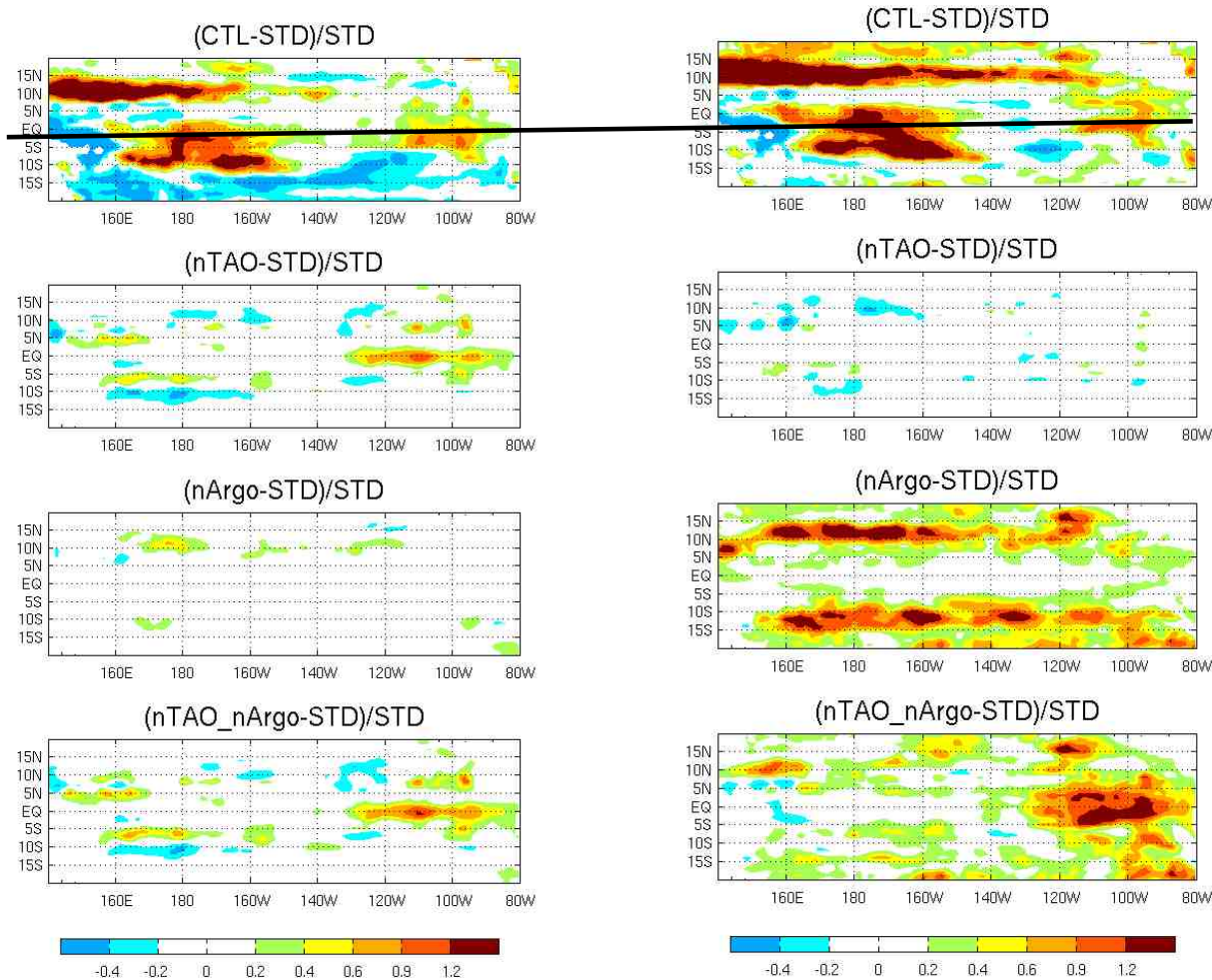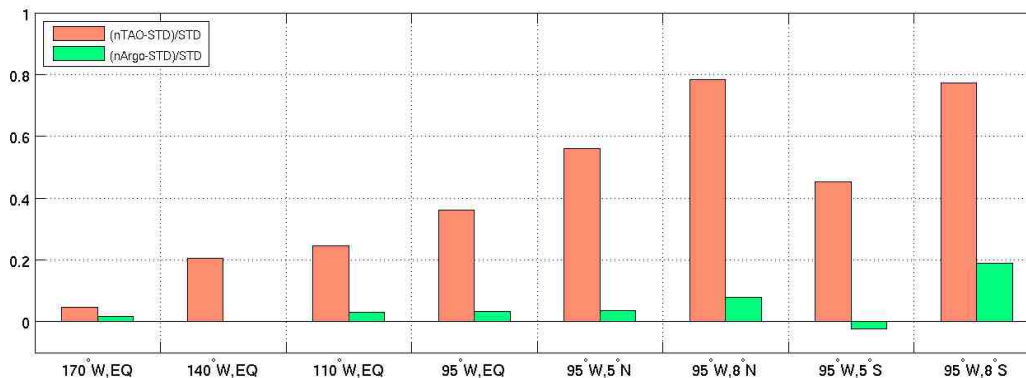

1999-2003

2004-2008

RMSE increased from STD to nTAO significantly in 1999-2003, but changed little after 2004 when Argo data were assimilated. RMSE increased from STD to nArgo by more than 80% poleward of 5ºN and 5ºS.

Comparison at TAO Buoys

Number of daily profiles from TAO (dark blue), Argo (yellow)
and XBT (light blue) near TAO buoy sites during 2004-2008.

**The result suggests that the TAO data plays a dominant role in
constraining model errors near the equator while the Argo data
plays a minor role in the presence of TAO data.**

OSE Experiments with GODAS_MOM4p1

(on GAEA, started in August 2012)

Data assimilated	CTL (no Ocean Data) (1990-2008) (R2 Fluxes)	CTL (no Ocean Data) (1990-2008) (CFSR fluxes)
XBT	×	x
TAO	×	x
Argo	×	x

However, the MOM4p1 model does not run smoothly on GAEA. The runs often stopped due to errors related to vapor pressure table.

Control Run with NCEP R2 Fluxes

(Comparison of 300m ocean heat content with GODAS)
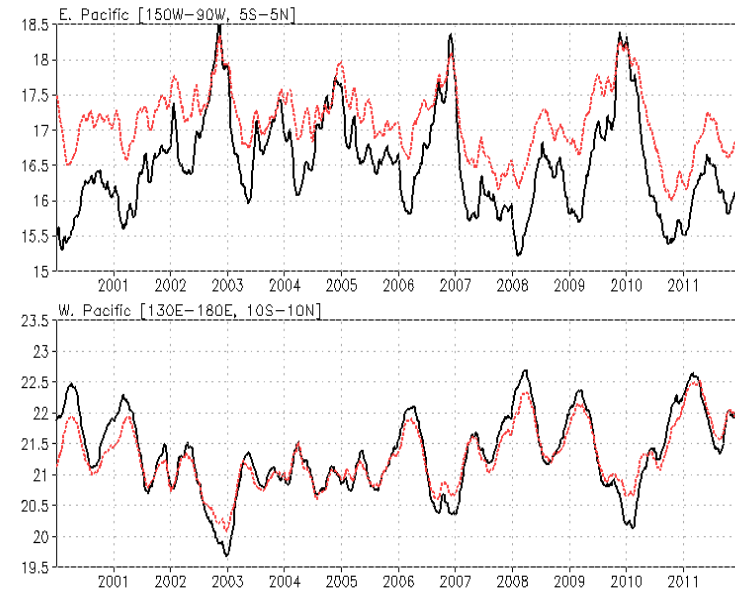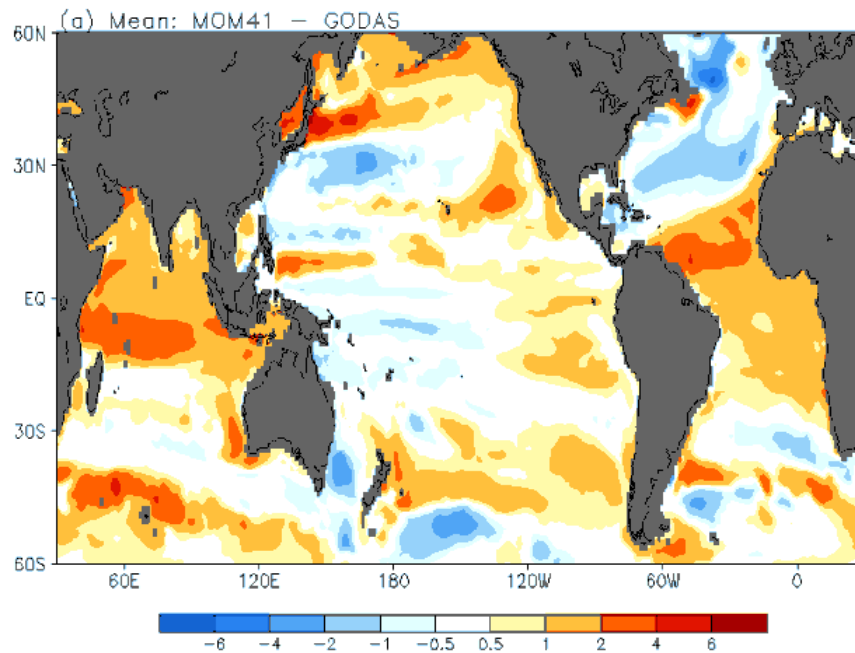
For the tropical Pacific, the model simulates the ocean heat content in the western Pacific reasonably well, but has warm bias in the equatorial eastern Pacific where the model thermocline is too diffuse, particularly during ENSO-neutral and La Nina years.